Endovascular Surgery for Internal Carotid Stenoses

Results of PTA vs. Stenting

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Summary

This paper will overview our results of endovascular therapy (PTA or stenting) for cervical ICA stenosis and discuss the advantages and disadvantages of each treatment. 60 cases with 62 lesions were treated with PTA 68 times, while 36 cases with 37 lesions were treated with stenting 37 times. A total of 99 lesions were treated with PTA or stenting 105 times. In the PTA group arterial stenosis improved from 76.4% to 21%. In the stent group the stenosis improved from 82.3% to 8.3%. The morbidity rate was 2/60 (3.3%) in PTA group, although two cases had minor neurological deficits, while in stent treated group, morbidity rate was 1/36 (2.8%), although it showed one major neurological deficit. Mortality was 0% in each group. The restenosis rate in PTA group was 15/58 (26%), while it was 0/20 (0%) in stent treated group. Stenting brings significant reduction of stenosis and reduces the rate of restenosis compared to PTA. However, stenting has its own disadvantages such as hypotension and distal kinks when deployed in tortuous ICA stenosis.

Introduction

Endovascular treatment for cervical internal carotid artery (ICA) stenoses has become popular due to the development of balloon catheters and stents [1-9,11,12]. We started endovascular therapy for internal carotid stenoses from 1991 with percutaneous transluminal angioplasty (PTA). PTA/stenting was later introduced from 1998. This paper will overview our results and discuss the advantages and disadvantages of each treatment.

Indication of PTA or PTA/stenting

Our indication of endovascular therapy for cervical ICA stenoses is as follows: 1) stenosis greater than 60%; 2) high medical risk for surgery (ischemic heart disease etc); 3) high surgical risk group (contralateral ICA occlusion, restenosis after CEA, high carotid bifurcation beyond C2); 4) patient age *70 years old, 5) patient preference.

Cases and Methods

60 cases with 62 lesions were treated with PTA 68 times. 36 cases with 37 lesions were treated with stenting 37 times. A total of 99 lesions were treated with PTA or stenting 105 times. For the PTA cases we always tried to use a distal protection system that was developed by us. In severe stenoses, predilatation was performed using a smaller sized balloon catheter such as a stealth balloon catheter. For stenting we initially used Palmaz stents (7 cases) but then stopped once self-expandable stents such

as Wallstent (21 cases) and SMART stent (9 cases) became available. In the PTA/stent cases we also always tried to use the distal protection system that we designed. The PTA balloon catheters used in our series were Stealth, Savvy, Opta-5, Ultrathin, Sub-4, Symmetry, or Accent. Antiplatelet therapy started at least 2 weeks before the treatment and continued. The procedure was performed under systemic heparinization which subsequently was continued for 1 to 7 days. We compared the following items between PTA and PTA/stenting: 1) improvement of stenosis, 2) morbidity and mortality, 3) restenosis, 4) complications.

Results

1) *Improvement of stenosis*: In the PTA group arterial stenosis improved from 76.4% to 21%. In the stent group the stenosis improved from 82.3% to 8.3%.

2) *Morbidity and mortality*: The morbidity rate was 2/60 (3.3%) in PTA group, although two cases had minor neurological deficits as shown below. In stent treated group, morbidity rate was 1/36 (2.8%), although it showed one major neurological deficit. Mortality was 0% in each group.

3) *Restenosis*: The restenosis rate in PTA group was 15/58 (26%), while it was 0/20 (0%) in stent treated group. Restenosis was evaluated in cases followed up more than 3 months and confirmed by angiography, MRA, or 3-D CT angiography. In our series restenosis was defined as stenosis greater than 70 %.

4) *Complications*:

1) Ischemic complications: Cases included are those that 1) demonstrated transient or permanent new neurological deficits without hemorrhagic complication on CT, or 2) demonstrated cerebral emboli on an angiogram after PTA or stenting. Cases that showed neurological deficits related to ICA occlusion during balloon inflation were excluded. Four ischemic complications (6.7%) appeared in the PTA group, one of which caused a permanent minor neurological deficit (partial visual field defect in one eye due to emboli to the branch of the central retinal artery). Two embolic complications (5.6%) were encountered in the stent treated group. One caused temporary neurological deficit and the other caused permanent major neurological deficits (right homonymous hemianopsia and right hemiparesis with 4/5 degree). All embolic complications appeared in cases treated without an embolic protection device.

2) Hemorrhagic complications: In one severe stenosis case with poor intracranial filling on angiography, a hyperperfusion hemorrhage (1.7%) appeared after PTA and neurological symptoms became aggravated. A putaminal hemorrhage was noticed on CT scan. This patient was treated by a reversal of heparin and a reduction of blood pressure. Fortunately, the complication caused only a minor neurological deficit.

3) Complications related to stenting: In one stent case for an associated ulceration, a Palmaz stent slipped from the mounted PTA balloon catheter. Subsequently, we snared the stent and retrieved it through the femoral artery. In the other case, a Wallstent was deployed under distal protection. The protection balloon catheter made a loop when introduced distal to the stenosis and this loop was trapped by stent. During withdrawal of the protection balloon catheter, the deployed stent deformed. Our treatment decision was to open the neck by surgery, perform carotid endarterectomy, and remove the stent. Four cases in the stent treatment group suffered from hypotension related to carotid sinus reflex. The symptoms continued for nearly a week and in one case dopamine infusion was necessary to increase the blood pressure for one day. Temporary pacing was not necessary in any of the cases.

Discussion

PTA did not always result in satisfactory dilatation because of wall dissections or elastic recoil. One of the advantages of stent treatment compared to PTA is the significant reduction of the stenosis by preventing elastic recoil or wall dissection. Additionally, the stent treated group demonstrated a significant reduction in the restenosis rate compared to the PTA treated group[3,11,12].

From those points of view, stent treatment seems to be superior to PTA. However, stent treatment has some disadvantages. One is the difficulty in delivery and deployment of a stent. A bigger guiding catheter is necessary to deliver the stent. In the case of balloon expandable stents, once a stent is introduced into the vessel

it is very difficult to retrieve it (although recently balloon expandable stents are not used for carotid stenosis because of the possible deformity due to an external force). In the case of self-expandable stents, accurate positioning is not always easy, and therefore, longer stents may be necessary to cover the entire lesion.

Two other types of stent trouble were encountered. One was stent migration and the other was stent dislocation. We must remember that it is sometimes very difficult to retrieve the stent without surgical removal in case of stent migration. In case of restenosis, although it seems rare compared to PTA group, carotid endarterectomy is not easy in stent deployed cases, especially when the stent has been placed in the distal ICA.

Stents can also possibly cause hypotension due to the continuous stimuli to the carotid sinus, especially in cases with heavy calcification or when a larger sized stent is used. In cases with tortuous ICA stenosis, if a stent is deployed in the lesion then the stent may stretch the artery and cause a distal kink. In this type of lesion, stent deployment may not be a good choice. A stent with the higher conformability should be developed in the future and a stent should not be deployed if PTA results in successful dilatation.

As for ischemic complication rate, the stent group and the PTA group seem similar. However, in two ischemic complication cases related to stent deployment, embolic complication happened during the post-dilatation procedure after stent deployment. It should be noted that these two cases occurred in the initial stent series that did not use distal protection. After these two cases we developed our original distal protection balloon catheter to prevent distal embolism. After introduction of this system no cases of clinical embolic complication occurred.

In the PTA group, all embolic complications appeared in cases treated without distal protection. From these points of view, we believe embolic protection system is definitely necessary [8-10].

Conclusions

Stenting brings significant reduction of stenosis and reduces the rate of restenosis compared to PTA. However, stenting has its own disadvantages such as hypotension and distal kinks when deployed in tortuous ICA stenosis. A protection system to prevent from distal emboli is definitely necessary to improve the results of PTA/stenting.

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